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ON SOLVING MATHEMATICAL TASKS BY PUPILS WITH SPECIAL EDUCATIONAL NEEDS

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Abstract. In the contribution we present a specimen of outcomes obtained from a pilot research conducted during a project aimed at verification of the new Czech curriculum for pupils with special educational needs. We include tasks falling into the area of mathematical literacy, which enable us to characterize pupils' competences.

1. Introduction

Mathematics is regarded as an important part of education and of cultural and historical background of a person. It is a tool of orientation in the world and a tool of not only thinking and prediction but also a tool for solving routine and unusual real-life problems and tasks. Mathematical literacy includes (cf. *European Commision: Second report on the activies of the Working Group on Basic Skills, 2003*) a set of knowledge, which a person is able to apply in areas such as family budget, shopping, travelling and free time, of special skills (such as the use of mathematical terminology or units, the use of tools and means – ICT). This means that people are able to recognize and understand mathematical problems, study them and use mathematics in their private life, work or among friends or relatives as constructive, active and pondering citizens [2].

The supplement of Framework Education Programme for Elementary Education on education of pupils with slight mental handicap stresses the fact that "an area of education is based on practical activities, application of

mathematical knowledge in real life, strengthens the ability to think logically and enhances space imagination. Pupils acquire basic mathematical concepts and symbols and techniques and their possible usage. They learn to be precise, to apply rules of mathematics, to use calculators and mathematical software. Mathematics penetrates all the basic education, gradually helps pupils to acquire mathematical literacy and teaches them skills which they can use in practice" [6, p. 22].

2. Aims and methodology of research

In our research we give a specimen of outcomes of a pilot research conducted during "Education of Children, Pupils and Students with Special Education Needs", which is the first Czech research aimed at verification of efficiency of changes introduced by the new curriculum for pupils with special needs.

The pilot research was performed in November and December 2008 at two elementary schools in Kyjov and Olomouc. It verified the methodology of data acquisition on a reference sample of 15 pupils chosen from the complete sample of pupils of the last year of elementary school by means of practically performed random sampling. Based on the experience obtained during the pilot research, the test materials, which are going to be used during the main research, were adjusted.

The test materials consist of three main parts characterized by the area of competence studied:

1. socio-personal and work competence,
2. competence of a reader and language competence,
3. mathematical competence.

We tested correctness and completeness of solution. The time allocated for the test was 1 lesson (= 45 minutes). After the lector hands in the worksheets, he or she comments the test (e.g. "read the test carefully, mark correct answers in a certain way – circle them, include or side calculations, etc."). The tested pupils are allowed to use their calculators.

3. Tasks and expected outcomes of the subject matter

1. Multiply 99 by 1,2,3, etc., 8, 9 respectively. Can you say whether (and why) the results are interesting?
   $99 \cdot 1 = \ldots$, $99 \cdot 2 = \ldots$, $99 \cdot 3 = \ldots$, $99 \cdot 4 = \ldots$, $99 \cdot 5 = \ldots$, $99 \cdot 6 = \ldots$, $99 \cdot 7 = \ldots$, $99 \cdot 8 = \ldots$, $99 \cdot 9 = \ldots$,

2. Count and complete the table:

Goods	1 kg	2 kg	3 kg	4 kg
Flour	14.70 Kč			
Rice	23.40 Kč			
Spaghetti	45.90 Kč			

Verify the calculations (use calculator) and round the results to tens.

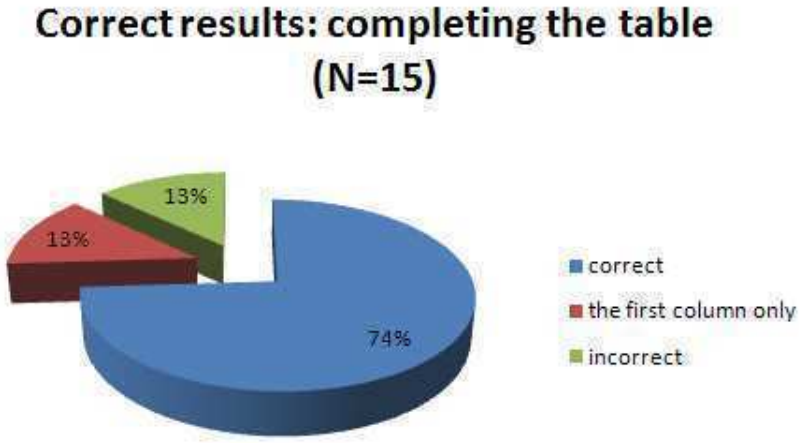

Figure 1: Percentage of students who completed the table correctly.

3. Eve decided to prepare a salad for her mothers' birthday. She will need half a kilo apples, two bunches of radishes, half a kilo of tangerines and kiwis. The prices at the supermarket she went to were:
Apples (1 kg) ... 22 Kč, Tangerines (1 kg) ... 35 Kč, Radishes (bunch) ... 6 Kč, Kiwi (1) ... 3 Kč
How much is Eve going to pay for all the salad ingredients?

   Pupils solve real-life situations and simple calculations of financial mathematics (tasks with money – shopping, savings, loans).

4. Complete the table using correct units:

Side of the square	30 mm			6 cm	10 cm
Perimeter of the square		16 cm			
Area of the square			25 cm^2		

Compare the data in the first and second columns:

The side of the square increased by ... mm, the perimeter incresed by ... mm and the area of the square increased by ... cm^2.

5. In the morning Phillip spends 10 minutes washing himself. Then he eats his breakfast, which takes him 15 minutes, brushes his teeth for 5 minutes. His walk to school is 20 minutes long. The lessons start at 8 o'clock. What time does Phillip have to get up in order not to be late for school?

   A) at 8 o'clock B) later than half past eight
   C) before 7 o'clock D) at 7:15

   Pupils manage simple procedures to find length, weight and time. They use the acquired data to describe reality and in simple calculations (change of units of time, weight, time).

4. Research results

We are going to discuss solution of tasks 2 only. Pupils results ($n = 15$) are given in graphs and commented. However, before the data is considered, we must mention that the test in mathematics was the last one to take at both schools. Pupils at both schools were visibly tired and some even demotivated to solve yet another set of tasks. This might have influenced pupils attention and care with which the tasks were worked out. On the other hand, the lector (based on experience with the pupils) suggested that it was not tiredness but lack of mathematical competence that caused the failure of some pupils.

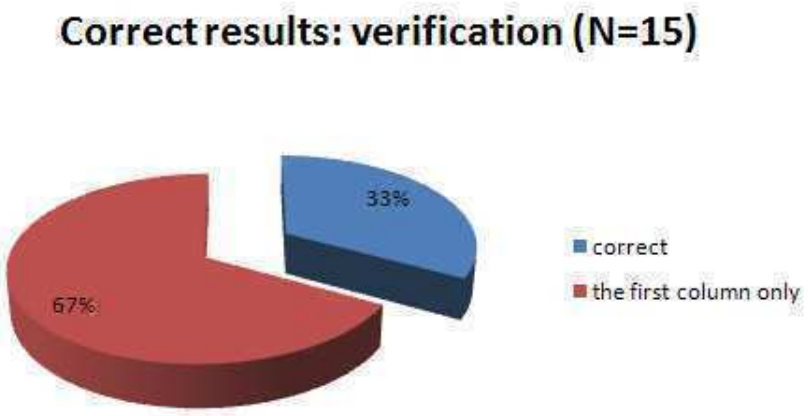

Figure 2: Percentage of students who verified the results correctly.

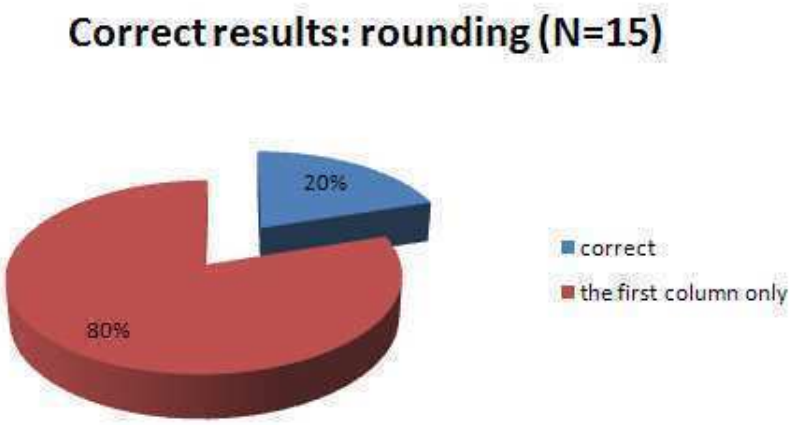

Figure 3: Percentage of students who rounded the results correctly.

We divided the solution of the task into three steps: completing the table (see Fig. 1), verification (see Fig. 2) and rounding (see Fig. 3). This division provedto be optimal during evaluation. As far as completing the table is concerned, three possible scenarios occurred – for details see Fig. 1. The pupils either completed the table correctly or wrote numbers without any sense (or having consulted the lector omitted this part because they did not know the way the task should be solved). Alternatively, they completed the first column only, i.e. dubbled the numbers.

Five pupils verified the solution while the remaining ten either did not perform any verification, or the verification was not correct. It could seem that Figures 1 and 2 do not match as more pupils calculated the task then verified the solution. However, some pupils who used their calculators did not include verification. Solving the task correctly and performing verification are independent and there indeed were pupils unable to deduce the way to verify the results from the correct numbers in the completed table.

Only 3 out of 15 pupils rounded all numbers correctly. For details see Fig. 3. These three pupils passed all three parts of the task. Simultaneously, they are the best solvers of all tested areas. Thus we could conclude that mathematical skills are a certain measure of intellectual abilities of the tested group of pupils.

5. Conclusion

There are significant differences between the pupils as far as solutions of the above tasks are concerned. The comparison of all three areas of the test resulted in the following finding: pupils who were very successful in linguistic

and mathematical parts of the test posses more elaborate and visible non-verbal communication means. On the other hand, pupils errors indicate an overall low level of mathematical competences. Pupils had problems with understanding word problems. As it was emphasized in [7], this is often a result of low level of reading comprehension. Even in spite of this fact, pupils were better at solving linguistic tasks. Solutions and results of some pupils might suggest that decimal numbers were a big problem. Some students even computed the results correctly but did not write the decimal point. We treated such solutions as correct if all other computations and solutions were correct. This is also true for solutions with small mistakes which can be obviously attributed to lack of attention instead of insufficient knowledge of mathematics.

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